



SMC3 gene

structural maintenance of chromosomes 3

Normal Function

The *SMC3* gene provides instructions for making a protein that is part of the structural maintenance of chromosomes (SMC) family. Within the nucleus, SMC proteins help regulate the structure and organization of chromosomes.

The protein produced from the *SMC3* gene helps control chromosomes during cell division. Before cells divide, they must copy all of their chromosomes. The copied DNA from each chromosome is arranged into two identical structures, called sister chromatids, which are attached to one another during the early stages of cell division. The *SMC3* protein is part of a protein group called the cohesin complex that holds the sister chromatids together.

Researchers believe that the *SMC3* protein, as a structural component of the cohesin complex, also plays important roles in stabilizing cells' genetic information, repairing damaged DNA, and regulating the activity of certain genes that are essential for normal development.

Although the *SMC3* protein is found primarily in the nucleus, some of this protein is transported out of cells. The exported protein, which is usually called bamacan, may be involved in sticking cells together (cell adhesion) and cell growth. Bamacan is a component of basement membranes, which are thin, sheet-like structures that separate and support cells in many tissues. Little else is known about the function of this protein outside the cell, but it appears to be important for normal development.

Health Conditions Related to Genetic Changes

Cornelia de Lange syndrome

At least 15 mutations in the *SMC3* gene have been found to cause Cornelia de Lange syndrome, a developmental disorder that affects many parts of the body. Researchers estimate that mutations in this gene account for 1 to 2 percent of all cases of this condition.

Most of the *SMC3* gene mutations that cause Cornelia de Lange syndrome either change single protein building blocks (amino acids) in the *SMC3* protein or add or delete a small number of amino acids in the protein. Each of these mutations alters the structure and function of the protein, which likely interferes with the activity of the cohesin complex and impairs its ability to regulate genes that are critical for normal development. Although researchers do not fully understand how

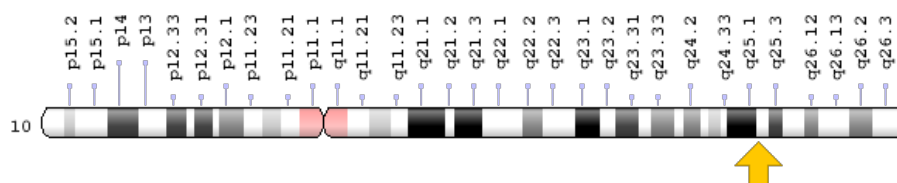
these changes cause Cornelia de Lange syndrome, they suspect that altered gene regulation probably underlies many of the developmental problems characteristic of the condition.

Studies suggest that mutations in the *SMC3* gene tend to cause a form of Cornelia de Lange syndrome with relatively mild features. Compared to mutations in the *NIPBL* gene, which are the most common known cause of the disorder, *SMC3* gene mutations often cause less significant delays in development and growth and are less likely to cause major birth defects.

Chromosomal Location

Cytogenetic Location: 10q25.2, which is the long (q) arm of chromosome 10 at position 25.2

Molecular Location: base pairs 110,567,691 to 110,604,634 on chromosome 10 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- BAM
- bamacan
- basement membrane-associated chondroitin proteoglycan
- BMH
- chondroitin sulfate proteoglycan 6
- chromosome-associated polypeptide
- CSPG6
- HCAP
- SMC3_HUMAN
- SMC3L1

Additional Information & Resources

Educational Resources

- Molecular Biology of the Cell (fourth edition, 2002): Cohesins and Condensins Help Configure Replicated Chromosomes for Segregation
<https://www.ncbi.nlm.nih.gov/books/NBK26931/#A3334>

GeneReviews

- Cornelia de Lange Syndrome
<https://www.ncbi.nlm.nih.gov/books/NBK1104>

Scientific Articles on PubMed

- PubMed
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28SMC3%5BTI%5D%29+OR+%28bamacan%5BTIAB%5D%29+AND+english%5Bla%5D+AND+human%5Bmh%5D>

OMIM

- STRUCTURAL MAINTENANCE OF CHROMOSOMES 3
<http://omim.org/entry/606062>

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
http://atlasgeneticsoncology.org/Genes/GC_SMC3.html
- ClinVar
<https://www.ncbi.nlm.nih.gov/clinvar?term=SMC3%5Bgene%5D>
- HGNC Gene Family: Cohesin complex
<http://www.genenames.org/cgi-bin/genefamilies/set/1060>
- HGNC Gene Family: Proteoglycans
<http://www.genenames.org/cgi-bin/genefamilies/set/570>
- HGNC Gene Family: Structural maintenance of chromosomes proteins
<http://www.genenames.org/cgi-bin/genefamilies/set/761>
- HGNC Gene Symbol Report
http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=2468
- NCBI Gene
<https://www.ncbi.nlm.nih.gov/gene/9126>
- UniProt
<http://www.uniprot.org/uniprot/Q9UQE7>

Sources for This Summary

- Ansari M, Poke G, Ferry Q, Williamson K, Aldridge R, Meynert AM, Bengani H, Chan CY, Kayserili H, Avci S, Hennekam RC, Lampe AK, Redeker E, Homfray T, Ross A, Falkenberg Smeland M, Mansour S, Parker MJ, Cook JA, Splitt M, Fisher RB, Fryer A, Magee AC, Wilkie A, Barnicoat A, Brady AF, Cooper NS, Mercer C, Deshpande C, Bennett CP, Pilz DT, Ruddy D, Cilliers D, Johnson DS, Josifova D, Rosser E, Thompson EM, Wakeling E, Kinning E, Stewart F, Flinter F, Girisha KM, Cox H, Firth HV, Kingston H, Wee JS, Hurst JA, Clayton-Smith J, Tolmie J, Vogt J, Tatton-Brown K, Chandler K, Prescott K, Wilson L, Behnam M, McEntagart M, Davidson R, Lynch SA, Sisodiya S, Mehta SG, McKee SA, Mohammed S, Holden S, Park SM, Holder SE, Harrison V, McConnell V, Lam WK, Green AJ, Donnai D, Bitner-Glindzicz M, Donnelly DE, Nellåker C, Taylor MS, FitzPatrick DR. Genetic heterogeneity in Cornelia de Lange syndrome (CdLS) and CdLS-like phenotypes with observed and predicted levels of mosaicism. *J Med Genet*. 2014 Oct;51(10):659-68. doi: 10.1136/jmedgenet-2014-102573. Epub 2014 Aug 14.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/25125236>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4173748/>
- Deardorff MA, Kaur M, Yaeger D, Rampuria A, Korolev S, Pie J, Gil-Rodríguez C, Arnedo M, Loeyes B, Kline AD, Wilson M, Lillquist K, Siu V, Ramos FJ, Musio A, Jackson LS, Dorsett D, Krantz ID. Mutations in cohesin complex members SMC3 and SMC1A cause a mild variant of cornelia de Lange syndrome with predominant mental retardation. *Am J Hum Genet*. 2007 Mar;80(3):485-94. Epub 2007 Jan 17.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/17273969>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1821101/>
- Ghiselli G. SMC3 knockdown triggers genomic instability and p53-dependent apoptosis in human and zebrafish cells. *Mol Cancer*. 2006 Nov 2;5:52.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/17081288>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1636066/>
- Gil-Rodríguez MC, Deardorff MA, Ansari M, Tan CA, Parenti I, Baquero-Montoya C, Ousager LB, Puisac B, Hernández-Marcos M, Teresa-Rodrigo ME, Marcos-Alcalde I, Wesselink JJ, Lusa-Bernal S, Bijlsma EK, Braunholz D, Bueno-Martinez I, Clark D, Cooper NS, Curry CJ, Fisher R, Fryer A, Ganesh J, Gervasini C, Gillesen-Kaesbach G, Guo Y, Hakonarson H, Hopkin RJ, Kaur M, Keating BJ, Kibaek M, Kinning E, Kleefstra T, Kline AD, Kuchinskaya E, Larizza L, Li YR, Liu X, Mariani M, Picker JD, Pié Á, Pozojevic J, Queralt E, Richer J, Roeder E, Sinha A, Scott RH, So J, Wusik KA, Wilson L, Zhang J, Gómez-Puertas P, Casale CH, Ström L, Selicorni A, Ramos FJ, Jackson LG, Krantz ID, Das S, Hennekam RC, Kaiser FJ, FitzPatrick DR, Pié J. De novo heterozygous mutations in SMC3 cause a range of Cornelia de Lange syndrome-overlapping phenotypes. *Hum Mutat*. 2015 Apr;36(4):454-62. doi: 10.1002/humu.22761. Epub 2015 Mar 17.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/25655089>
- Revenkova E, Focarelli ML, Susani L, Paulis M, Bassi MT, Mannini L, Frattini A, Delia D, Krantz I, Vezzoni P, Jessberger R, Musio A. Cornelia de Lange syndrome mutations in SMC1A or SMC3 affect binding to DNA. *Hum Mol Genet*. 2009 Feb 1;18(3):418-27. doi: 10.1093/hmg/ddn369. Epub 2008 Nov 7.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/18996922>
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